WHAT IS CLAIMED IS:

1. A method for processing an input optical signal having a first power spectrum among a plurality of carrier wavelength channels, the method comprising:

separating the input optical signal into a first beam and a second beam;

propagating the first beam through a component assembly via a path;

counter-propagating the second beam through the component assembly via substantially the same path; and

processing the first beam and the second beam using the component assembly such that an output optical signal formed using the processed first and second beams has a second power spectrum among the plurality of wavelength channels.

2. The method of claim 1, wherein processing the first and second beams comprises imparting wavelength-dependent gain to the first and second beams.

3. The method of claim 1, wherein processing the first and second beams comprises imparting wavelength-dependent attenuation upon the first and second beams.

4. The method of claim 1, wherein the component assembly comprises at least one filter.

5. The method of claim 4, wherein the at least one filter comprises:

a crystal set;

a first polarization-dependent routing element on a first side of the crystal set; and

a second polarization-dependent routing element on a second side of the crystal set.

6. The method of claim 5 wherein at least one of the first and second polarization-dependent routing elements is a polarization beam splitter.

7. The method of claim 5, wherein the component assembly comprises a plurality of crystal sets and a plurality of polarization-dependent routing elements, wherein the crystal sets and the polarization-dependent routing elements are positioned in an alternating sequence along the path, the alternating sequence beginning and ending with polarization-dependent routing elements.

8. The method of claim 1, wherein separating the input optical signal further comprises separating the input optical signal at a particular spatial location, the method further comprising combining at the particular spatial location the first beam and the second beam to form the output optical signal.

9. The method of claim 1 wherein processing the first and second beams comprises:

adjusting the phase of the first and second beams in response to a first control voltage; and

adjusting the amplitude of the first and second beams in response to a second control voltage.

10. The method of claim 1 wherein separating the input optical signal comprises spatially decomposing the optical signal into the first beam having a first polarization and the second beam having a second polarization orthogonal to the first polarization.

11. The method of claim 10 wherein separating the input optical signal comprises processing the input optical signal using a polarization beam splitter such that the first beam propagates along the path in a first direction and the second beam propagates along the path in a second direction that is opposite from the first direction.

12. The method of claim 1 wherein the first power spectrum is unequal among the plurality of wavelength channels and the second power spectrum is substantially equal among the plurality of wavelength channels.

13. The method of claim 1 wherein the first power spectrum is unequal among the plurality of wavelength channels and the second power spectrum has a substantially linear slope with respect to change in the wavelength channels of the output optical signal.

14. The method of claim 1 wherein the component assembly has a first transfer function determined by the processing of the first and second beams, and further comprising communicating the output optical signal to an optical component having a second transfer function.

15. The method of claim 14 wherein the first transfer function is based, at least in part, upon the second transfer function.

16. The method of claim 15 wherein the first transfer function pre-compensates, at least in part, for the optical component's second transfer function.

17. The method of claim 1, wherein the component assembly comprises a plurality of filters which define a transfer function through the component assembly, and wherein each filter is associated with an element in a frequency-domain series approximation of a target transfer function, whereby the transfer function as defined by the plurality of filters approximates the target transfer function.

18. The method of claim 17 and further comprising the following whereby the transfer function is adjusted to better approximate the target transfer function:

adjusting an amplitude coefficient parameter of a particular filter in response to a first control voltage; and

adjusting a phase coefficient parameter of the particular filter in response to a second control voltage.

19. The method of claim 18, wherein the frequency-domain series approximation comprises a Fourier series approximation.

20. The method of claim 1, wherein:

the first beam propagates through the component assembly at a plurality of spatial locations within the path; and

the second beam propagates through the component assembly at the same plurality of spatial locations within the path such that spatially dependent

imperfections associated with the component assembly affect the first beam and the second beam substantially similarly.

21. A method for processing an input optical signal having a first power spectrum among a plurality of wavelength channels, the method comprising:

providing a plurality of filters along a path, each filter associated with an element in a frequency-domain series approximation of a target transfer function, the plurality of filters comprising a component assembly;

separating the input optical signal into a first beam and a second beam;

propagating the first beam through the component assembly via the path;

counter-propagating the second beam through the plurality of filters of the component assembly via substantially the same path; and

processing the first beam and the second beam using the component assembly to apply a first transfer function to the input optical signal such that an output optical signal formed using the processed first and second beams has a second power spectrum among the plurality of carrier wavelengths.

22. The method of claim 21, wherein applying the first transfer function comprises:

adjusting an amplitude coefficient parameter of a particular filter in response to a first control voltage; and

adjusting a phase coefficient parameter of the particular filter in response to a second control voltage.

23. The method of claim 21, wherein processing the first and second beams comprises imparting wavelength-dependent gain to the first and second beams.

24. The method of claim 21, wherein processing the first and second beams comprises imparting wavelength-dependent attenuation upon the first and second beams.

25. The method of claim 21, wherein the at least one of the plurality of filters comprises:

a crystal set;

a first polarization-dependent routing element on a first side of the crystal set; and

a second polarization-dependent routing element on a second side of the crystal set.

26. The method of claim 25 wherein at least one of the first and second polarization-dependent routing elements is a polarization beam splitter.

27. The method of claim 25, wherein the component assembly comprises a plurality of crystal sets and a plurality of polarization-dependent routing elements, wherein the crystal sets and the polarization-dependent routing elements are positioned in an alternating sequence along the path, the alternating sequence beginning and ending with polarization-dependent routing elements.

28. The method of claim 21 wherein the first power spectrum is unequal among the plurality of wavelength channels and the second power spectrum is substantially equal among the plurality of wavelength channels.

29. The method of claim 21 wherein the first power spectrum is unequal among the plurality of wavelength channels and the second power spectrum has a substantially linear slope with respect to change in the wavelength channels of the output optical signal.

30. The method of claim 21 wherein the component assembly has a first transfer function determined by the processing of the first and second beams, and further comprising communicating the output optical signal to an optical component having a second transfer function.

31. The method of claim 30 wherein the first transfer function is based, at least in part, upon the second transfer function.

32. The method of claim 31, wherein the first transfer function pre-compensates, at least in part, for the second transfer function.

33. The method of claim 21 wherein the frequency-domain series approximation comprises a Fourier series approximation.

34. The method of claim 21, wherein:

the first beam propagates through the component assembly at a plurality of spatial locations within the path; and

the second beam propagates through the component assembly at the same plurality of spatial locations within the path such that spatially dependent imperfections associated with the component assembly affect the first beam and the second beam substantially similarly.

35. An optical device for processing an input optical signal having a first power spectrum among a plurality of wavelength channels, the optical device comprising:

a beam displacer operable to separate the input optical signal into a first beam and a second beam; and

an optical equalizer communicatively coupled to the beam displacer, the optical equalizer comprising a component assembly and arranged such that the first beam is propagated through the component assembly via a path in one direction and the second beam is propagated through the component assembly via substantially the same path in the opposite direction.

36. The optical device of claim 35 wherein the first beam is propagated via the path, beginning over a first segment of the path, and the second beam is propagated via the path, beginning over a second segment of the path.

37. The optical device of claim 36, further comprising a reflector which terminates the first and second path segments and receives the first and second beams over the first and second path segments respectively, the reflector being operable to reflect the second beam back over the first path segment in the direction opposite from which the first beam arrived, and further operable to reflect the first beam back over the second path segment in the direction opposite from which the second beam arrived.

38. The optical device of claim 37 wherein the reflector directs the beams using total internal reflection.

39. The optical device of claim 37 wherein the component assembly comprises at least two filters positioned along the path, with at least one filter positioned on the first path segment and at least one filter positioned on the second path segment.

40. The optical device of claim 37 wherein the component assembly is operable to process the first beam and the second beam such that an output optical signal formed using the processed first and second beams has a second power spectrum among the plurality of wavelength channels.

41. The optical device of claim 40, wherein the processing of the first and second beams comprises imparting wavelength-dependent gain to the first and second beams.

42. The optical device of claim 40, wherein the processing of the first and second beams comprises imparting wavelength-dependent attenuation upon the first and second beams.

43. The optical device of claim 39 and further comprising a controller operable to monitor the power spectrum output from the equalizer and to adjust parameters of the at least two filters in order to control the filters so that the power spectrum of an output signal generated by the equalizer approximates a target power spectrum.

44. The optical device of claim 35 wherein the beam displacer is a rhomboid prism having a polarization beam splitting portion that separates the input optical signal according to polarization.

45. The optical device of claim 44 wherein the first beam comprises a first polarization of the input optical signal and wherein the first beam passes through the polarizing beam splitting portion substantially unaffected and wherein the second beam comprises a second polarization of the input optical signal and wherein the second beam is reflected by the polarizing beam splitting portion.

46. The optical device of claim 45 wherein the rhomboid prism further comprises a reflective surface for reflecting the second beam, which was reflected by the polarization beam splitting portion, and wherein the first and second beams propagate substantially in parallel after the second beam has been reflected from the reflective surface.

47. The optical device of claim 35 wherein the beam displacer comprises a birefringent element which refracts one polarization of the optical signal to spatially separate the first and second beams which derive from the optical signal.

48. The optical device of claim 35 and further comprising a beam combiner for combining the first and second beams after passing through the optical equalizer.

49. The optical device of claim 48 wherein the beam displacer and the beam combiner are a single optical element that performs both the separation of the input optical signal into the first beam and the second beam and the re-combination of those beams into the output optical signal.

50. An optical device for processing an input optical signal having a first power spectrum among a plurality of carrier wavelengths, the optical device comprising:

a beam displacer operable to separate the input optical signal into a first beam and a second beam and to re-combine the first and second beams to form an

output optical signal having a second power spectrum among the plurality of carrier wavelengths after optical processing;

a plurality of filters positioned such that the first beam passes through the plurality of filters in a first direction and the second beam passes through the plurality of filters in a second direction, and further positioned such that the first and second beams pass again through the beam displacer after being optically processed by the plurality of filters; and

a controller operable to monitor the second power spectrum of the output optical signal and to adjust parameters of at least two of the plurality of filters in order to control the filters so that the second power spectrum approximates a predetermined target power spectrum.

51. The optical device of claim 50 wherein the beam displacer is comprised of separate optical elements for separating the input optical signal into first and second beams and combining the first and second beams, after processing, into an output optical signal.

52. The optical device of claim 50 wherein the first power spectrum is unequal among the plurality of wavelength channels and the second power

spectrum is at least substantially equal among the plurality of wavelength channels.

53. The optical device of claim 50 wherein the first power spectrum is unequal among the plurality of wavelength channels and the second power spectrum has a substantially linear slope with respect to change in the wavelength channels of the output optical signal.

54. The optical device of claim 50 wherein the component assembly has a first transfer function determined by the processing of the first and second beams, and wherein the output optical signal is provided to an optical component having a second transfer function.

55. The optical device of claim 50 wherein the plurality of filters define a first transfer function and wherein each filter is associated with an element in a frequency-domain series approximation of a target transfer function, whereby the first transfer function defined by the plurality of filters approximates the target transfer function.

56. The optical device of claim 55 wherein the frequency-domain series approximation comprises a Fourier series approximation.

57. The optical device of claim 50 wherein:

the first beam propagates through the plurality of filters at a plurality of spatial locations along a path; and

the second beam propagates through the plurality of filters at the same plurality of spatial locations within the path such that spatially dependent imperfections associated with the component assembly affect the first beam and the second beam substantially similarly.

58. A method for processing an input optical signal, the method comprising:

separating the input optical signal into a first beam and a second beam;

propagating the first beam through a component assembly having at least a first optical component and a second optical component, the first beam passing in a first direction through the first optical component and subsequently through the second optical component;

propagating the second beam through the component assembly, the second beam passing in the first direction through the first optical component and subsequently through the second optical component;

reflecting the first beam back through the component assembly, the reflected first beam passing in a second direction through the second optical component and subsequently through the first optical component; and

reflecting the second beam back through the component assembly, the reflected second beam passing in the second direction through the second optical component and subsequently through the first optical component;

whereby the optical processing performed on the first and second beams is performed by the passing of each of those beams in the first and second directions through at least the first and second optical components.

59. The method of claim 58 wherein the component assembly comprises a plurality of filter elements and wherein at least a single stage of filtering is provided by the plurality of filter elements acting on the beams passing through the plurality of filter elements in both the first and second directions.

60. The method of claim 59 wherein the plurality of filter elements comprise a polarization-dependent routing element and at least one crystal element and wherein the first and second beams pass through the polarization-dependent routing element in the first direction before passing through the at least one

crystal element and wherein the first and second beams, after reflection, pass through the at least one crystal element in the second direction before passing again through the polarization-dependent routing element.

61. The method of claim 60 wherein the polarization-dependent routing element is the first optical component and wherein the at least one crystal element is the second optical component.

62. The method of claim 58 wherein the first beam is passed in the first direction through the first and second optical components via a first path segment and back through the second and first optical components in the second direction via a second path segment that is substantially parallel to the first path segment, and wherein the second beam is passed in the first direction through the first and second optical components via the second path segment and back through the second and first optical components in the second direction via the first path segment.

63. The method of claim 62 wherein the first and second path segments are spatially separated from each other.

64. The method of claim 62 wherein the first and second path segments are substantially coextensive with each other.

65. The method of claim 58 and further comprising combining the first and second beams after they have passed in the first and second directions through at least the first and second optical components.

66. The method of claim 58, wherein the component assembly comprises a liquid crystal located before a set of crystal elements in the propagated direction and after the set of crystal elements in the reflected direction.

67. The method of claim 66 wherein the liquid crystal is the first optical component and the set of crystal elements is the second optical component.

68. A method for filtering an input optical signal having a first power spectrum among a plurality of wavelength channels, the method comprising:

separating the input optical signal into a first beam and a second beam;

propagating the first beam through an optical filter comprising a polarization-dependent routing element and at least one crystal element, wherein the first and second beams pass in a first direction through the polarization-dependent routing element and subsequently through the at least one crystal element;

propagating the second beam through the optical filter, the second beam passing in the first direction through the polarization-dependent routing element and subsequently through the at least one crystal element;

reflecting the first beam back through the optical filter, the reflected first beam passing in a second direction through the at least one crystal element and subsequently through the polarization-dependent routing element; and

reflecting the second beam back through the optical filter, the reflected second beam passing in the second direction through the at least one crystal element and subsequently through the polarization-dependent routing element;

whereby the optical filtering performed on the first and second beams is performed by the passing of each of those beams in the first and second directions through at least the polarization-dependent routing element and the at least one crystal element.

69. The method of claim 68 wherein the first and second path segments are spatially separated.

70. The method of claim 68 wherein the first and second path segments are substantially coextensive.

71. The method of claim 68 and further comprising combining the first and second beams after they have passed in the first and second directions through at least the polarization-dependent routing element and the at least one crystal element.

72. An optical device for processing an input optical signal having a first power spectrum among a plurality of carrier wavelengths, the optical device comprising:

an input which receives the input optical signal;

a beam separator positioned to receive the input optical signal from the input and to separate the input optical signal into a first beam traveling along a first optical path and a second beam traveling along a second optical path;

a reflector positioned to terminate both the first optical path and the second optical path, the reflector operable to reflect the first beam such that it travels along the second optical path and to reflect the second beam such that it travels along the first optical path; and

a plurality of filter elements positioned along both the first optical path and the second optical path, optically between the beam separator and the reflector, such that the first beam travels through the plurality of filter elements along the first path before it is reflected, and again along the second path after it is reflected, such that the second beam travels through the plurality of filter elements along the second path before it is reflected and again along the first path after it is reflected.

73. The optical device of claim 72, wherein the plurality of filter elements comprises a polarizer positioned such that both the first beam and the second

beam pass through the polarizer before passing through at least one of the plurality of filter elements.

74. The optical device of claim 72, wherein the plurality of filter elements comprises a liquid crystal positioned such that both the first beam and the second beam pass through the liquid crystal before passing through at least one of the plurality of filter elements.

75. The optical device of claim 72, wherein the beam separator is a beam displacer which spatially separates one polarization of the input optical signal from another polarization of the input optical signal to form the first and second beams, respectively.

76. The optical device of claim 72, wherein the first and second optical paths are substantially coextensive with each other.

77. The optical device of claim 76 and further comprising a redirecting element which is operable to receive the first beam when it is traveling along the second optical path after having been reflected and to receive the second beam when it is traveling along the first optical path after having been reflected and to redirect those beams away from their substantially coextensive common paths.

78. An optical device for processing an input optical signal having a first power spectrum among a plurality of carrier wavelengths, the optical device comprising:

an input which receives the input optical signal

a beam separator positioned to receive the input optical signal from the input and to separate the input optical signal into a first beam traveling along a first optical path and a second beam traveling along a second optical path;

a reflector positioned to terminate both the first optical path and the second optical path, the reflector operable to reflect the first beam such that it travels along the second optical path and to reflect the second beam such that it travels along the first optical path;

a polarizer positioned adjacent to the beam separator along the first and second optical paths;

a plurality of filter elements positioned along both the first optical path and the second optical path, optically between the polarizer and the reflector, such that the first beam travels through the plurality of filter elements along the first path before it is reflected and again along the second path after it is reflected, such that the second beam travels through the plurality of filter elements along the second path before it is reflected and again along the first path after it is reflected; and

a redirecting element which is operable to receive the first beam when it is traveling along the second optical path after having been reflected and to receive the second beam when it is traveling along the first optical path after having been reflected and to redirect those beams away from their substantially coextensive common paths.

79. The optical device of claim 78, wherein the plurality of filter elements comprises a liquid crystal positioned such that both the first beam and the second beam pass through the liquid crystal before passing through at least one of the plurality of filter elements.